Digital Imaging Infrastructure

Alberto F. Goldszal, PhD
Imaging Sciences,
WGM Clinical Center, NIH

IMAGING SCIENCES

PACS/RIS/DIN Definitions

PACS = Picture Archiving & Communications Systems

RIS = Radiology Information System

DIN = Digital Imaging Network

- PACS/RIS are medical devices, not merely information systems.
- Complex automation systems for acquiring, transmitting, managing, storing and displaying digital diagnostic images and associated text information.
- PACS/RIS systems are the application of information age technology to *improve the quality and efficiency* of radiology services.
- Enable integration of new and existing medical record data including image, biosignal, textual and demographic data toward a filmless and paperless operation.

Why PACS/RIS?

- Decrease number of repeated examinations.
- Decrease/eliminate film and chemical costs.
- Decrease turnaround time of exams.
- Improve access to prior studies.
- Improve the quality of images.
- Decrease frequency of misidentified images.
- Improve equipment availability.
- Improve efficiency of after-hours interpretation.
- Improve availability of images and reports.
- Minimize/eliminate lost films.
- Low fat, tastes great!

Additional Motivation for PACS/RIS

- Acquire, distribute and archive images from all medical imaging modalities in digital form;
- Use fast networking for transferring and accessing any part of a patient's file from any location within NIH/outside;
- Reduce the time needed for an examination to become available to the attending and referring physicians;
- Support to interhospital data exchange (teleradiology/telemedicine).
- Improve medical image interpretation with the use of image processing tools (e.g., multimodality image registration, segmentation, enhancement, etc.);
- Facilitate short- and long-term image and medical data archiving.

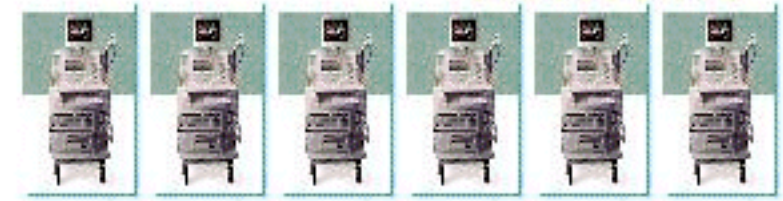
NIH Imaging Sciences: Imaging Modalities

MRI

Angio

Fluoro

Ultrasound



Ultrasound Mini-PACS

CT

CT

DR

CR

PACS/RIS
Data Center

Digital Imaging
Network

Film Digitizer

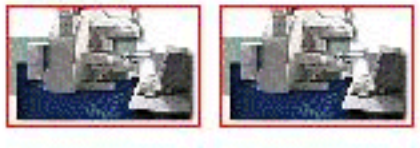
Mammo

MRI
(Suburban Hospital)

OC-12

Nuclear Medicine

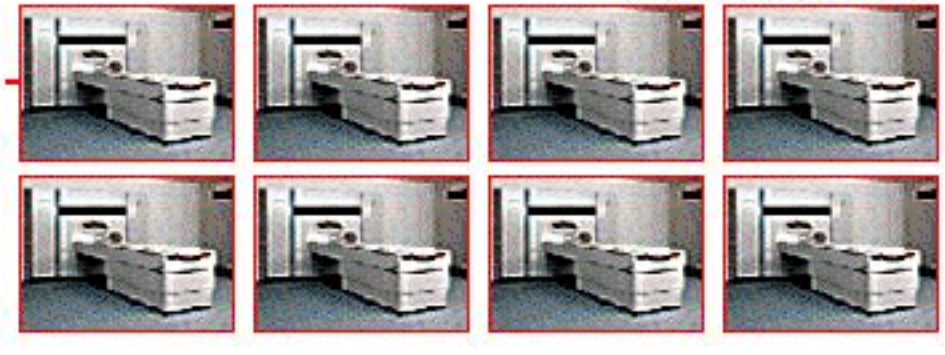
PET



Nuc Med/PET
Mini-PACS

(future)

NMR Center



PACS/RIS Data Management Center

DICOM Servers

Study Server w/ Fibre Channel RAID

ArchiveManager Workflow Router

AutoRads Workgroup

DICOM Servers

Archive Manager 1
9740 @ 13 TB

Archive Manager 2
9740 @ 13 TB

ArchiveManager Redundancy Unit

Wet/Dry Film/Laser Printers

Clinical Access Server

DICOM/jpeg

Web Server, 200/2000

DICOM/jpeg

Any validated DICOM Q/R

Hot-spare

RS6000

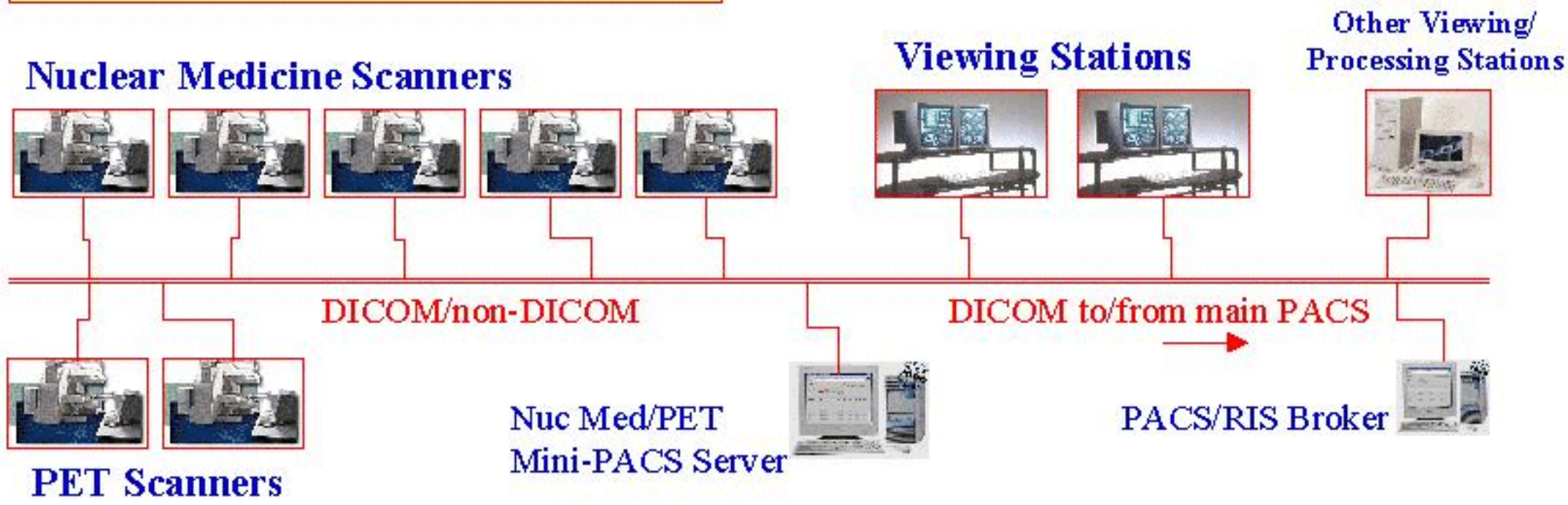
PACS/RIS Broker

RIS

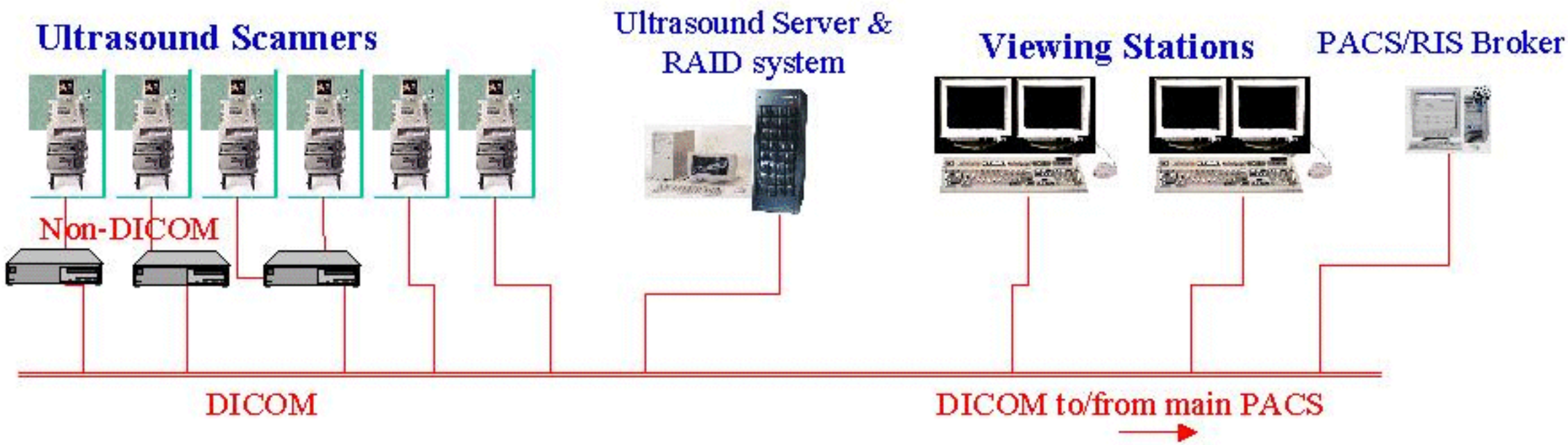
HL-7

HIS/MIS

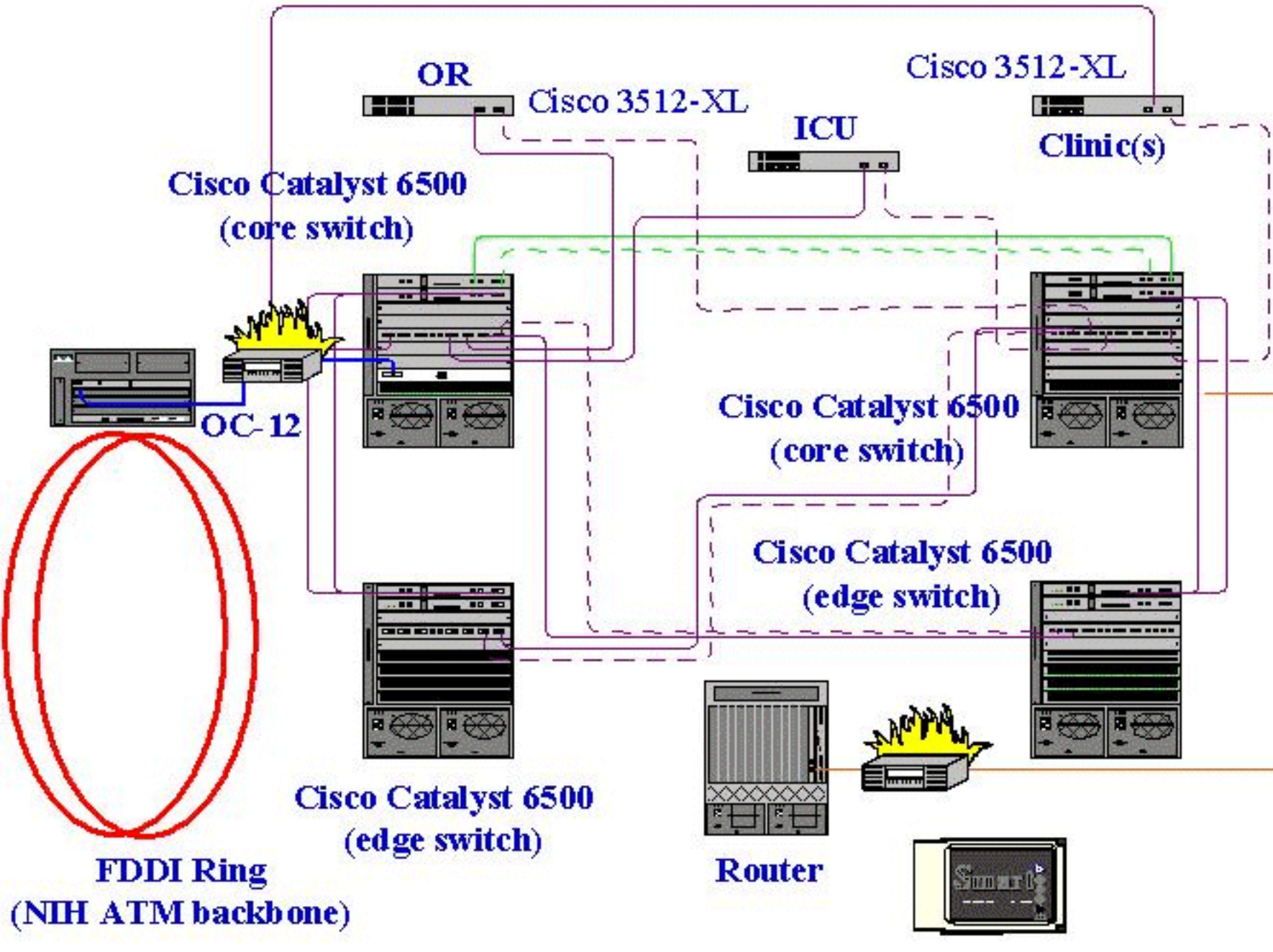
Nuc Med/PET Mini-PACS



Ultrasound Mini-PACS



Digital Imaging Network



- Redundant (at highest level) meshed network;
- High-performance, gigabit and multi-layer intelligence (up to 150Mpps);
- 4GB backbone (full-duplex), 32GB backplane;
- Support multiple protocol and VLAN switching;
- Initially, network with 225 copper drops; each drop consists of 2 CAT5 cables using redundant wire paths;
- Fiber cabling for 25 drops;
- Cisco Works 2000 network monitoring package;
- 24x7 coverage by Kodak;
- Two Pix firewall servers (full redundancy); encryption soft; VPN soft; Secure ID; PACS/RIS security policy

PACS/RIS/HIS Workflow

4
Imaging Modality

DICOM Gateway

Images →

Images →

DICOM Storage
← Commitment

← Study status

5
PACS Archive

DICOM Modality
← Worklist

Pre-fetch images →
Route images →

Rule-based
priors

HIS

1

ADT, Orders,
Schedule →

3

Workflow and
Worklist
Manager

← Radiologist
worklist

Q/R

PACS/RIS
Broker

2

RIS

Status,
Results,
Charges

HL-7

Images

Images,
Reports

Study read/
verified

6

Dx W/S

Reports

8

Enterprise-wide □Access

← Q/R →

Web Server:
Images & Reports

Clinical Server:
Images & Reports

7

Clinical W/S

PACS: Web Solution

Scanner

Server

Reading Station

Tape

RAID

Disk

Tape

Push New Imgs

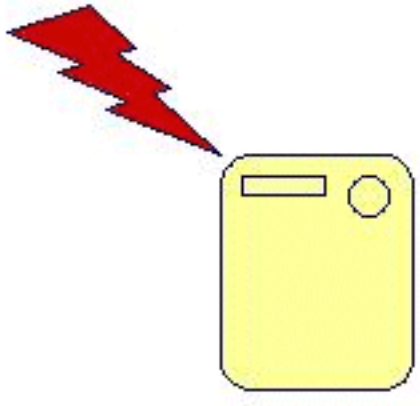
Q/R

Physician/ Scientist

Q/R

Email

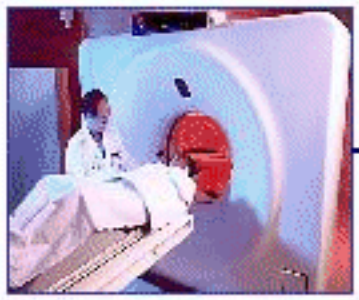
Web-server



1-800-NIH BEEP

Pager

PACS and Image Processing



Scanner

Server

Reading Station

DLT

RAID

Disk

DLT

Web-server

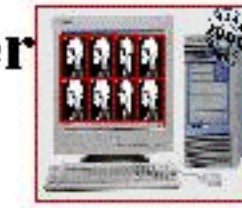


Image Segmentation	Synthesis of Parametric Images
Computational Anatomy	Data Visualization
Multimodality Image Registration	Image-guided surgery and treatment planning